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Connecting the social and the ecological in the focal species concept: case study of White Stork

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Abstract

In this article we provide an overview of five case studies of initiatives using the image of White Stork as a focal species. Our case studies are preceded by a short overview of existing approaches to achieve broader environmental goals through species conservation and a review of the social, ecological and social-ecological importance of White Stork. With the use of the above, we investigate linkages, complementarity and friction between the ecological, social and social-ecological perspectives on focal species, and eventually propose a framework for a more multi-targeted approach. The proposed concept of a social-ecological keystone species recognises social-ecological system complexity and goes beyond traditional divisions into ecological and social. Our approach extends the cultural keystone species concept to tie into new spheres – modern societies with more indirect connections to nature as well as indigenous communities, and all forms of human relationships with other species, not just for consumption – and to explicitly include the ecological significance of a species. Apart from serving as a potentially highly useful conservation proxy, a social-ecological keystone species emerges as a vehicle for ecological literacy, expanding from an interest in a species to learn more about the system of which it is part. White Stork, with its long history of coexistence with humans and many linkages with specific cultural practices offers an excellent example for discussing the broader social-ecological relevance of species in establishing meaningful connections to nature.

Keywords

Social-ecological keystone species, keystone species, flagship species, cultural keystone species, social-ecological systems

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Introduction

Conservationists select certain species as a focus of their activities – or at least for public relations or visibility purposes (Tisdell and Swarna Nantha 2007; Clucas et al. 2008). They compete for attention and funds with other messages that are also promoted in a similar way, using key, spectacular, sometimes shocking pieces of news (Kotler et al. 2002). The selection of species is often based on emotions or *ad hoc* reasoning, rather than a broad understanding of these species by the addressees of these campaigns (Home et al. 2009; Żmihorski et al. 2013), not to mention their ecological importance. However, for this approach to be effective, these species need to be selected with due care to ensure the conservation of habitats and many other species connected to them (Kontoleon and Swanson 2003). Interestingly, species "importance" has also been argued based on a deeper understanding of the social-ecological interactions that have led to the prominence of certain species for certain social groups, as reflected in the concept of cultural keystone species (Cristancho and Vining 2004; Garibaldi and Turner 2004). In this article, our objective is to investigate the linkages between the ecological, social and social-ecological approaches to the focal species idea, and to highlight the potential of a more comprehensive social-ecological approach to address multiple targets simultaneously.

We provide an overview of the different perspectives on what constitutes particularly important species present in environmental conservation and social sciences, and eventually bring these different perspectives together to scrutinise the White Stork (*Ciconia ciconia*). The example of White Stork helps us identify outstanding issues that need to be addressed in future discussions on focal species. White Stork holds a particularly high social/cultural status in most areas where it is present (Kronenberg et al. 2013) and it is also recognised as an umbrella species and used as an ecological indicator (Tobolka et al. 2012). Thus, this species provides an interesting case for studying the different ways in which a single species can be conceived of and used in specific circumstances and to achieve various outcomes. We investigate five campaigns that either focused on White Stork conservation or relied on the special status of this species among the general public as an argument for broader nature conservation. Eventually, we analyse the focus on White Stork in each case study campaign: whether it was its social/cultural appeal only, or an understanding of its broader social-ecological importance. In the discussion section, we suggest that the previously considered ecological, social and social-ecological approaches to focal species could be broadened to cover additional aspects of the species' importance. We highlight the merits of using the more inclusive concept of social-ecological keystone species in the broader context of environmental conservation and conclude with some suggestions on how and why species should be selected for conservation purposes.

Different perspectives on the selection of particularly important species

Several concepts have been proposed to denote focal species, organisms particularly important from the point of view of nature conservation, each with its own "myriad of

definitions and applications" (Zacharias and Roff 2001: 60). Some of these concepts focus on the ecological importance of species (keystone, umbrella and indicator species in particular) while others refer principally to their social perception (flagship, symbolic and iconic species in particular) (see Tables 1 and 2 for exemplary definitions). Although these concepts focus on single species, these species are meant to represent broader conservation purposes. Many of these concepts are often used interchangeably and academic discussion continues with regard to which of them are the most accurate as proxies for nature conservation (Simberloff 1998; Kontoleon and Swanson 2003; Caro et al. 2004; Roberge and Angelstam 2004; Favreau et al. 2006).

Some authors (e.g. Carignan and Villard 2002) suggest that for scientific reasons ecological criteria for selecting focal species seem to be more relevant for conservation purposes than social criteria. Indeed, as a social construct, flagship species can be selected and promoted with the use of creative processes involving conservationists, artists, media specialists and other stakeholders. They are often selected in response to widespread ecological illiteracy where keystone, indicator and umbrella species may not necessarily be known to or appreciated by the wider society. Besides, people may be more concerned with the loss of a charismatic species than with the loss of habitat, and they may not necessarily be able to see the link between habitat loss and threats to the species (Entwistle et al. 2000).

However, to some extent, all of these concepts involve social and ecological aspects, albeit to a varying degree. The perceived ecological importance of species is based on social knowledge, cultural norms and values. Conservation projects are built on the knowledge of their authors and preferences of their sponsors. Modern approaches to conservation often draw on local traditional knowledge, citizen science and many other forms of stakeholder involvement (Berkes 2009).

Meanwhile, the socially oriented selection frameworks involve at least some level of ecological knowledge, at the very least on the part of those who promote certain species as socially important. Flagship species may be selected based on their conservation status (Rodrigues et al. 2006), population size, ecological importance (Home et al. 2009), although – probably most often – what counts is their appearance, charisma and utility (Walpole and Leader-Williams 2002; Serpell 2004; Martín-López et al. 2008; Veríssimo et al. 2009; Ullmann and Stachowitsch 2015). Appearance is mostly related to large body size, physical attractiveness and likeability which involve some kind of similarity to humans (Gunnthorsdottir 2001; Tisdell et al. 2006) or relatively babyish looks which trigger affection in adult humans (Gould 1980). Charisma may be related to appearance (aesthetic and corporeal charisma) or it may relate to broader detectability and distinctiveness of species (Lorimer 2007). Utility refers to people's perceptions of the benefits related to those species or their instrumental value (Serpell 2004). Human preferences towards species also depend on broader social and cultural values, the physical and behavioural characteristics of species, people's knowledge of those species, and finally "past and present interactions with particular species, including cultural factors, such as religiosity or traditional practices, and social factors, such as property relationships or recreational use" (Martín-López et al. 2007: 68). In any case, selection criteria depend on context and purpose, e.g. at which level (local, national, global) a species is going to be presented

Table 1. Concepts focusing on the special ecological importance of a species.

Concept	Definition/understanding
Keystone species	Species that has a particularly significant impact on the state of a community or an ecosystem (disproportionate to the species' abundance or biomass) (Mills et al. 1993; Power et al. 1996; Simberloff 1998).
Foundation species	Highly interactive and abundant species, playing a dominant role in an ecosystem, a less restrictive variant of the keystone concept (Soulé et al. 2003).
Umbrella species	Species which have relatively large habitat/area requirements and saving them automatically saves many other species (Simberloff 1998: 249).
Indicator species	Used to monitor environmental conditions and community/habitat/ecosystem composition (Carignan and Villard 2002). Similarly, sentinel species, usually used as biomarkers (Lower and Kendall 1990; Bossart 2006), and signal species (Uliczka and Angelstam 2000) have been used to signal environmental change.

Table 2. Concepts focusing on the special social importance of a species.

Concept	Definition/understanding
Flagship species	"Popular charismatic species that serve as symbols and rallying points to stimulate conservation awareness and action" (Leader-Williams and Dublin 2000: 56; based on: Heywood 1995: 491).
Charismatic species	"Immediately recognizable and identifiable by name, (…) commonly associated with a particular geographic location or habitat" (Kontoleon and Swanson 2003: 483).
High-profile species	Often used in exchange for flagship, widely recognised species (e.g. Scott et al. 1995).
Poster species	A species which qualifies to be used on a poster promoting a given conservation campaign (Jacquet and Pauly 2008).
Iconic species	Reflecting the "wider social, economic and ecological roles" of those species (Everard and Kataria 2011: 101).
Symbolic species	Holding a symbolic, cultural, religious value, e.g. an animal serving as a national emblem (e.g. Sattout et al. 2007).
Totemic species	Bearing special, totemic importance for indigenous communities (Descola and Palsson 1996); but also – more broadly – totemising or totemisation of certain species equals attributing special features to those species in public discussions – highlighting our moral and ethical obligations towards those species (Kalland 1993).
Species that sells	Used to 'sell' conservation ideas or objectives, attracting funds to conservation (Kontoleon and Swanson 2003), but sometimes also used by companies to sell market goods.
Tourism flagship species	A species of particular importance from the point of view of attracting tourists (Walpole and Leader-Williams 2002; Veríssimo et al. 2009).
Species with a high wow-factor	Quantification of relative interest levels for different species based on pair-wise comparisons. A measurement of an observer's relative level of enjoyment derived from spotting such species in the wild (Heydinger 2014). Closely linked to species rarity.
Bambi effect	Cute and cuddly, anthropomorphic and sentimentalised, activating "protective instinct which prevents humans wanting to kill or consume animals" (Ferreday 2012: 88).
Local flagship species	Species which are important to local people and are used purposefully to promote conservation within local communities (Bowen-Jones and Entwistle 2002).

(Jepson and Barua 2015). Eventually, at the far end of the socially informed concepts, species are disconnected from their conservation context and used purely for branding or attention grabbing (e.g. species that sell, tourism flagship species).

Many authors have already argued that flagship species would serve their purposes better, had they not only reflected their social importance but also the ecological importance (Heywood 1995; Simberloff 1998; Home et al. 2009). Connecting these two approaches to particularly important species would seem essential for engaging with co-evolving social-ecological systems. Several authors realised that the perception of different focal species has to be considered not only from the point of view of those who are going to sponsor conservation but also related to those who are most closely linked to those species, i.e. local communities which co-exist with those species on an everyday basis (Entwistle 2000; Bowen-Jones and Entwistle 2002). Local perception of the importance or value of those species emerged as an important success factor for effective conservation efforts, ensuring the participation of local communities (Veríssimo et al. 2009). Entwistle (2000) and Bowen-Jones and Entwistle (2002) highlighted the importance of local values, perceptions and attitudes, and made connections to cultural symbolism and self/community identity. Bowen-Jones and Entwistle (2002) and Walpole and Leader-Williams (2002) focused mostly on the risk that a species of high symbolic value for people willing to pay for conservation may not be equally desirable to those living next to this species (who may see this species as a nuisance), e.g. a tiger or a lion.

These ideas are quite comprehensively reflected in the concept of cultural keystone species (Cristancho and Vining 2004; Garibaldi and Turner 2004; Platten and Henfrey 2009). Cultural keystone species embrace the special utilitarian but also spiritual and symbolic importance of species to different cultures, "essential to the stability of a cultural group over time" and whose "withdrawal from the culture's context would entail significant cultural disruptions" (Cristancho and Vining 2004: 155). The main focus here is on the importance of such species for indigenous societies, and on how those societies depend on such species – for food, energy, medicine, building materials but also in the psycho-socio-cultural sphere. Indeed, in some cases these species have been used to define the identity of specific human communities. Eventually, the keystone role is not only performed by a species alone, but by a complex of a species and its ecological relationships, social artefacts, knowledge, practices, beliefs, ideas, norms and values (Platten and Henfrey 2009).

Although cultural keystone status does not necessarily coincide with the ecological prominence of those species, it often reflects the traditional ecological knowledge. As a result of the strong dependence of indigenous communities on nature, ecologically "valuable" species tend also to be socially valuable. However, this is not always the case and it does not have to reflect the specific keystone, indicator or umbrella status of a species. It does, however, underline the co-evolutionary character of social-ecological systems and again suggests that any understanding of a species' importance is a social construct.

Methods

Based on a literature review, we describe the importance of a selected well-known species, which often serves as a conservation conduit – the White Stork. The selection of literature for this review was aided by our previous work on this species. In line with

the overview of the different perspectives on particularly important species presented in the previous section, we divided the results of our review into the ecological, social, and social-ecological aspects.

To provide an in-depth analysis of the articulation of the focal species concept in the case of White Stork, we pay special attention to five case examples, mostly drawing from recent conservation practice. For each case study, we investigated the involved stakeholders, the time of a campaign, its objectives, addressees (and what was expected from them), activities involved, communication channels used to reach the relevant audiences, and outcomes. We also analysed in which way the White Stork was used in a given campaign, and what it symbolised.

The existing frameworks for selecting focal species serve as the basis for our social-ecological account and the case descriptions reflect the most important issues addressed in the concepts developed so far, complemented with a broader social-ecological systems thinking. The description of each case study is based on the review of publicly available resources, combined with additional information sought from the relevant project representatives.

The social and ecological importance of White Stork

Ecological context

Among farmland birds, the White Stork seems to be a good indicator of both environmental conditions and habitat diversity (Tobolka et al. 2012). First of all, it is an icon of nature conservation in Europe and elsewhere (Creutz 1985) and data on stork population size, and even breeding success, have been collected in some places since 1890 (Bairlein 1991). It is charismatic and easy to detect – it builds huge, easily located nests on electricity poles, high chimneys and roofs of buildings, and it is easy to find a sufficient sample size (Tobolka et al. 2012). For these reasons, its presence is often used as an argument for habitat conservation, especially wetlands, and the cultural character of changing farmland (Tryjanowski et al. 2006). On a more detailed level, White Storks can be used as environmental indicators based on the concentration of heavy metals in their blood and feathers (Tryjanowski et al. 2006; Kamiński et al. 2008). Additionally, White Storks are highly visible during their migration and can be used as indicators of environmental problems along the migratory route. According to the IUCN, the White Stork is of Least Concern in terms of its conservation status globally, which means that it enjoys low extinction risk.

The presence of White Stork provides benefits to other species. White Stork nests are known as good nesting sites for other bird species (Indykiewicz 1998; Kosicki et al. 2007), and they may be of key importance for the survival of some species in winter (Tobolka 2011). White Stork nests are also important as seed banks for seed plants, including rare vascular plant species (Czarnecka and Kitowski 2013), and the soil in the nest is a habitat for saprophagous mites (Błoszyk et al. 2005).

From the point of view of agriculture, White Stork probably plays an important pest regulative role as it feeds, among other species, on the Common Vole *Microtus*

arvalis, which can cause serious damage to crops, especially in meadows, pastures and perennial crops (clover, alfalfa). Indeed, in the so-called murine years the number of pairs of storks and their reproductive success increase (Tryjanowski and Kuzniak 2002). However, the stork is unlikely to be a key species for predatory control of vole populations and it has not been shown to what extent the stork contributes to reducing them. In Africa, in wintering grounds, the White Stork is a valuable predator on Brown Locusts *Locustana pardalina* in the Grassy Karoo where swarms occur (Vesey-FitzGerald 1959; Milstein 1966). Similarly, in grassland and woodland habitat, the White Stork is attracted to caterpillar outbreaks (Herremans and Herremans-Tonnoeyr 1993).

Social context

Several accounts of the special cultural importance of White Stork have been published in national languages in countries where White Stork is present, indicating the prominent cultural role of this species (Bense 2006, 2014; Kronenberg et al. 2013). White Storks are present in folklore, as reflected in numerous beliefs and traditions, but also modern social norms. Their close connections with people (nesting and feeding close to human settlements) and the resulting familiarity as well as their relatively anthropomorphic look and the qualities frequently ascribed to them (such as fidelity, wisdom, caregiving, nobility) make them almost unequivocally considered friendly and close to humans.

White Storks are widely represented in art, which is not only restricted to literature, paintings and folk arts, but extends to applied arts and industrial design, including toys, jewellery, household appliances, clothes, souvenirs and various collectible goods (postcards, stamps, phone cards, beverage bottles etc.). They serve as important symbols, being considered one of the key 'national birds' by the Belarusians, Danish, French, Germans, Hungarians, Lithuanians, and Polish. For example, they are featured in national promotional campaigns in Poland, and in local coats of arms in Poland and elsewhere (e.g. the Hague). Furthermore, the image and symbolism of White Stork is also exploited for commercial purposes by companies ranging from infertility treatment clinics, through restaurants and hotels located close to storks' nests, an on-line shop offering Polish produce to Polish immigrants in the UK, to many companies offering products and services seemingly unrelated to storks (see our case study 5 which solely relied on the symbolic meaning of the stork, without any consideration of environmental facts and factors). Finally, because of their familiarity, White Storks are frequently used in ecological education projects, with one database featuring several hundreds of such undertakings in Poland alone.

Social-ecological context

Although White Stork is a particularly prominent species, especially from a cultural perspective, its significance is different than in the case of species traditionally used as examples of cultural keystones (Cristancho and Vining 2004; Garibaldi and Turner

2004). However, inasmuch as a species can have a cultural keystone status in a modern, industrialised society, the White Stork meets the relevant criteria (Table 3). Although we agree with Platten and Henfrey (2009: 496) that "No approach of this type, based on lists of features, can be usefully diagnostic of cultural keystones, which in the absence of a formal systems model can be identified only in reference to contingent features of any particular case," we still find it useful to check how White Stork fares with regard to the cultural keystone criteria put forward so far.

Here, we focus on the role of White Stork in European countries where this is a widely known and common species (such as Poland, Lithuania, Hungary or Germany). We see the national level as the most relevant for discussing the concept of a social-ecological keystone species in a modern, industrialised society, although we also admit that such an analysis could be performed for a distinguishable cultural group. Clearly, in a modern society, dependence on a species is more indirect, not necessarily involving the direct, instrumental or use value related to consumption. White Storks are charismatic enough that almost everyone derives satisfaction from observing them as part of a traditional rural landscape. So the criteria from Cristancho and Vining (2004) and Garibaldi and Turner (2004) which emphasise the instrumental value related to direct, physical use or trade in the species are less relevant.

Additionally, as already indicated, the social-ecological perspective should not only suggest that the species is important because of co-evolutionary interdependence between the social and the ecological, it should also reflect a more objective ecological role of a species in question. Although the White Stork is not a keystone species, it is still important enough in an ecosystem, either as an indicator or – at least to some extent – as an umbrella species, that it fits into the broader concept of a social-ecological keystone species. This indicates the relevance of the local flagship species concept (Bowen-Jones and Entwistle 2002), which incorporated both social and ecological criteria and therefore was used in our comparison in Table 3.

Case studies: White Stork as a focal species

Case study 1: White Stork and illegal hunting in Lebanon

Bird hunting in the Mediterranean countries have long been a source of concern for European bird conservation organisations (BirdLife International 2010). Recently, with the development of social media, conservation organisations have discovered the photos, which illegal hunters had posted on their profiles of themselves and their trophies, and – based on these new proofs – demanded concerted European action and political pressure to be exerted on countries such as Lebanon to protect migrating birds more effectively (CABS and LEM 2013). This campaign had little resonance in Poland until the pictures of White Storks killed by Lebanese poachers and displayed in their social media profiles were shown to the public (Kozera 2014). The images of piles of White Storks shot illegally in Lebanon roused public opinion, creating a window

Table 3. Does the White Stork meet criteria for a cultural keystone species? Criteria from major articles on cultural keystone species and the related concept of a local flagship species have been collated in rows according to their relative proximity.

Criteria			In what way does the white stork meet these criteria?
Cristancho and Vining (2004)	**Garibaldi and Turner (2004)**	**Bowen-Jones and Entwistle (2002)**	
The story of the species' origin is tied to the myths, the ancestors, or the origin of the culture.	Role in narratives, ceremonies, or symbolism.	Cultural significance – folklore, arts, food etc.	Prominent status in legends, myths, folklore.
The species is either related to or used in activities intended to supply the basic needs of the community such as getting food, constructing shelters, curing illnesses, etc.	Intensity, type and multiplicity of use.		According to historical records, because of respect and various beliefs, storks were consumed only as the extreme last resort. Material from storks' nests as well as parts of stork's body were used as medicaments until eighteenth century. Not relevant any more. Today, non-material use of storks as a widely recognised symbol dominates.
The species is central to the transmission of cultural knowledge.	Persistence and memory of use in relationship to cultural change.	Traditional knowledge.	Only through folklore.
The species is indispensable in the major rituals on which the community's stability depends.	Naming and terminology in a language.	Common names – without negative connotations or interpretations in local languages.	The coming of spring – expected sign.
The species has significant spiritual or religious value for the culture in which it is embedded.	–	Positive associations.	Highly respected, featuring only positive associations.
The cultural group refers to the species as one of the most important species.	Level of unique position in culture.	Charisma.	Prominent role as a national symbol, as well as in arts and design. Symbol of traditional rural landscape.
The species exists physically within the territory that the cultural group inhabits or to which it has access.	–	Geographical distribution – present in the area of interest.	Common in many countries.
–	Extent to which it provides opportunities for resource acquisition from beyond the territory.	–	n/a

Criteria			In what way does the white stork meet these criteria?
Cristancho and Vining (2004)	**Garibaldi and Turner (2004)**	**Bowen-Jones and Entwistle (2002)**	
–	–	Recognition – known to the target audience.	Widely known worldwide.
–	–	Existing usage – avoiding conflicting symbolism.	Widely used to symbolise different things, none of which is in conflict with conservation.
–	–	Conservation status – not necessarily rare, may be common for better recognition.	Common, widely recognised and respected.
–	–	Ecological role – central role in the ecosystem preferably.	Not central, but important.

Table 4. Summary of our case studies.

	White Stork and illegal bird hunting in Lebanon	**European Stork Villages Network and other stork villages**	**White Stork reintroduction programme in Sweden**	**"Almost gone" campaign by NABU**	**Commercial use of the White Stork image by Atlas**
Coordinator	Polish NGOs led by Grupa Ekologiczna	NGOs in several countries led by EuroNatur	Swedish NGOs: Swedish Society for Nature Conservation in Scania and the Scanian Ornithological Society	German NGO: Nature and Biodiversity Conservation Union (NABU)	Private company: Atlas
Objectives	Migratory bird conservation	Habitat conservation, local development	Habitat and bird conservation, local branding	Nature conservation, ecological education	Marketing products (not related to conservation)
Addressees	Broader society	Donors, tourists, broader society	Broader society	Broader society	Consumers
Use of white stork	Images, symbolism, rhetoric	Information, symbolism	Information, symbolism	Images, information, symbolism	Images, symbolism
Focal species concept	Flagship species, umbrella species, social-ecological keystone species	Flagship species, umbrella species, tourism flagship species, species that sells	Flagship species, umbrella species, social-ecological keystone species	Flagship species, species that sells, iconic species, indicator species	Species that sells

of opportunity which Polish conservation organisations have successfully exploited to pursue further activities in Lebanon (for an overview of our case studies, see Table 4).

In 2013, referring to the importance of White Stork for the Polish society, several environmental NGOs (led by Grupa Ekologiczna) started to put pressure on Lebanese authorities to take action. Simultaneously, in cooperation with the Polish embassy in Beirut and Lebanese conservation organisations, they launched an educational campaign in Lebanon, highlighting that the Lebanese society has important responsibility to protect storks on their way to and from Poland. The involvement of the diplomatic mission stressed that killing migratory birds (storks in particular) negatively affected the image of Lebanon in Poland. In Lebanon posters, leaflets and a video documentary were distributed in schools and research organisations, at public events, and among other interested stakeholders, along with some organised presentations on this topic. In 2015, a photo contest was organised for the best photo featuring White Stork, with a trip to Poland to take part in ringing storks as the first prize. In Poland additional awareness raising activities were carried out through the use of traditional and social media, with several opportunities for the general public to get involved in this campaign (e.g., sending emails and postcards to the prime minister of Lebanon). Satellite tracking of one stork during its migration – especially when crossing the territory of Lebanon – attracted additional attention to this campaign in both countries. The cam-

paign has continued in subsequent years; in 2017 Polish activists showed a 10-minute animated cartoon in Lebanese schools, and distributed 1000 copies to Lebanese children. Over time, this campaign has raised interest in Lebanese and Polish media. It has led to regulatory changes improving conservation and a higher determination to execute the law in Lebanon (level of government), and hopefully increased awareness among the general public.

As a charismatic, flagship species, White Stork was able to attract broad attention to the problem of illegal bird hunting in Lebanon (or to "sell" the broader conservation objectives). However, most prominently, this case study presents White Stork as a social-ecological keystone species, or at least a local flagship species.

Case study 2: European Stork Villages Network and other stork villages

Since 1994, EuroNatur awards the European Stork Village title to a village that protects a White Stork nesting colony and in this way helps to reverse the loss of traditional agricultural habitat. Local stakeholders in European Stork Villages are expected "to enhance the living conditions of the White Stork, such as preserving or rewilding large open wet meadows or erecting artificial stork nests" and to increase environmental awareness of inhabitants and visitors (Wiesehomeier et al. 2014: 2). European Stork Villages are places of cultural activities focused on the topic of White Stork and its conservation, as well as of interaction between conservation organisations and local communities (Ferger and Schwaderer 2016). Several other stork villages undertake similar activities, without being part of the Network which only features one village per country.

In Central and Eastern Europe White Storks currently usually nest solitarily. Although the several dozens of colonial nesting sites of White Stork in Poland are seen as spectacular natural spots, few have been successfully marketed as tourist attractions and even fewer have become the focus of large-scale conservation activities. Zywkowo in the north-east of the country provides the best example of a combination of both objectives. Conservation and tourism promotion activities have been carried out there since 1997 by the Polish Society for the Protection of Birds (PTOP) within the "Stork Village" project.

As a conservation organisation, PTOP has been primarily interested in protecting natural habitats and biodiversity, which have been increasingly exposed either to development pressure (especially intensive agriculture) or to changes related to land abandonment (afforestation, secondary succession). To counteract these pressures, which would have resulted in the loss of the typical landscape mosaic and the storks' foraging grounds, PTOP attracted significant funding from international and national donors to buy and lease land, renovate buildings, maintain an organic farm with traditional breeds of horses and cows, and create tourist infrastructure. Subsequent projects were carried out not only in Zywkowo, but also in several other "stork villages" in north-east Poland, all of which aimed at the conservation of natural foraging grounds for the

storks (increasing water retention and improving water quality, supporting extensive agriculture, improving the storks' nesting conditions etc.). Seven villages have been connected under the Warmian-Masurian White Stork Tourist Trail, with some national scale promotional activities, including brochures, posters, website, basic tourist infrastructure, ecological education activities and infrastructure, and national media coverage. Zywkowo has remained the most popular village within the trail, annually visited by 2000–5000 tourists (c.f. Czajkowski et al. 2014), and a prominent conservation project which continues until today.

Local stakeholders in stork villages are expected to contribute to nature conservation and to increase environmental awareness of inhabitants and visitors. Thus, White Stork serves as an umbrella species (for other species, for landscape mosaic, for the whole ecosystem) and a tourism flagship species. The different projects carried out by PTOP in this area have been successful in preventing the degradation of the stork habitats, and they have also attracted tourists to stork villages. This further indicated that the potential of birdwatching tourism is higher than usually assumed, because it involves not only specialised tourists, but also casual ones who are lured to attractions such as stork villages (Kronenberg 2016). Hence, part of the effort has been directed at creating and maintaining the stork village brand (Kronenberg 2015; Ferger and Schwaderer 2016).

Case study 3: White Stork reintroduction programme in Sweden

The first half of the 20th century saw the decline and final disappearance of White Stork from Sweden, with the last unsuccessful attempt at breeding in 1954 (Nilsson 1989). The decline was probably driven by several factors, most prominently landscape change. Wetlands were drained and converted into agricultural fields and the extent of semi-natural grasslands was reduced, effectively removing much of the habitat on which the stork depends. This development, overall landscape change as well as the disappearance of storks, was seen as undesirable by many and in 1989 the Swedish Society for Nature Conservation (SSNC) in Scania (the southernmost province of Sweden) and the Scanian Ornithological Society (SkOF) initiated a reintroduction programme for White Stork.

The programme aims to bring back free, breeding and migrating storks to Sweden and much of the media attention and public focus is on the breeding programme (storks were first brought in from Algeria via Switzerland, later Poland). However, the reintroduction programme is paralleled by landscape restoration efforts, primarily aimed at restoring wetlands and it was early progress here that convinced SSNC and SkOF that it was time to start with the Swedish Stork Programme (Rimberth 2013). During the last decades, however, the work of restoring wetlands has intensified, at least partly in response to the reintroduction programme. The landscape has been very much influenced by people over millennia (Karlsson 1989) and the White Stork is for many people an expression of this history (Cavallin 1997). The possibilities to

reconstruct the "landscape of the stork" and thereby bring back the stork constitute a significant driving force in many ongoing restoration projects, such as the Swedish Stork Programme.

The stork is described as a flagship species in text written by the Stork Programme and in information relating to the programme. Depending on audience and objective we contend that the stork, as used in the region, can be considered a flagship species, an umbrella species or an indicator species. Participation in the restoration programme has also been used by municipalities and organisations to brand their environmental engagement. The stork is the main attractor for tourism, guided tours, environmental education and public engagement in nature conservation, all of which fit in well under the flagship identity. However, because of the stork's role in maintaining the culturally meaningful landscape, the stork bears a deeper social-ecological meaning. Indeed, the success of the reintroduction programme is also used as an indicator of the progress of the landscape restoration efforts, and by implication (and often explicitly stated) biodiversity conservation or promotion.

Case study 4: "Almost gone" campaign by NABU (Germany)

"Almost gone" campaign was launched in 2009 to attract interest and funding for nature conservation, focusing on the problem of disappearance of seemingly common and widely known species. Using examples of species that have experienced significant population declines in Germany in the past decades, the campaign informed that extinction may also concern familiar, national species, which most people do not consider threatened. These included White Stork, Wolf, Tree Frog, Apollo Butterfly and Cod, each of which could only be seen in part, disappearing from the picture.

The campaign included over 4700 posters displayed in billboards in all major German railway stations and along major roads, plus online banners, flyers and postcards, and short commercials shown in regional television channels.

The stork was selected as one of the flagship species because it is familiar to everyone and yet the risks that it faces are not so well-known. Although the stork typifies many animal species that are threatened with extinction (at least in Germany), its importance was reinforced by the fact that this species is featured in NABU logo (i.e. an iconic or totemic species). Along with other species, the stork was also partly considered an indicator species because its presence was connected to the condition of its habitats (and to habitat loss).

Case study 5: Commercial use of the White Stork image by Atlas

Atlas, the largest Polish manufacturer of construction chemicals, is widely recognised not only for its products but also because of its association with White Stork, which the company has been using as its symbol and mascot. The company was established in

1991, in the early period of Polish socio-economic transformation, and it started to use White Stork in a large scale outdoor advertising campaign already in 1993. Since then, about 1500 advertisement poles featuring the company's logotype and a laminate White Stork on a nest have been planted all over the country (about 1250 remain until today). This campaign was so successful in making the brand widely recognised and popular that White Stork has become the central concept in subsequent promotional activities ("everything else was thought around the storks" (Adam Masiulanis, personal communication)). This has started to change relatively recently when the company decided that even though the association with White Stork is genuinely positive and has been very successful in terms of creating the company's image, it is not promising enough in terms of building the brand further. Thus, the main focus has been placed on other activities, such as trainings for key customers and business partners and a trade magazine. Nevertheless, the White Stork has remained a prominent symbol and mascot, widely used in various promotional activities, especially those involving sports and children.

Interestingly, the selection of this species was a pure coincidence and its use has never been backed up with proper market analyses. In the early 1990s, the advertising market in Poland was poorly developed and any original idea had huge chances of becoming a success. Only over time – once the campaign started to bring effects – various commentators have developed deeper meaning for the use of White Stork by Atlas. The species which had first been seen as an impressive crowning of an advertisement pole, became a symbol of the Polish origin of the company, of the good constructor (referring to the storks' nests), and a source of many other positive emotions and connotations. Clearly, the ecological connotations of White Storks were not considered in this case and the company did not sponsor White Stork conservation projects, except for some incidental instances.

Interestingly, recent survey among construction professionals revealed limited potential to capitalise on this project for conservation purposes (Bocian 2017). Twenty-six percent of survey respondents associated Atlas with the image of White Stork, however only fifteen percent considered such associations as an important argument for choosing the company's products. Most importantly, 91% of respondents suggested that Atlas should sponsor White Stork conservation projects, and most commonly they indicated that the company should spend 1–2% of its revenue in this way. Interestingly, in 2013 the company's revenues exceeded 560 million PLN (181 million USD), and it only spent 49,200 PLN (16,000 USD) sponsoring one project related to White Stork conservation between 2012 and 2015.

Although this case study does not represent a nature conservation project, it illustrates the broader social connotations of focal species, and especially the 'species that sells' concept (selling commercial products rather than environmental conservation). To some extent, it has become a totemic species for Atlas. Although the company did not reveal willingness to pay for White Stork conservation in this case, this does not preclude other more witty opportunities to capture the hidden potential of capitalising on such corporate practices. Indeed, through its extractive activities, the company negatively influences White Stork habitats, which might provide further arguments to generate funds for White Stork conservation.

Discussion

Insights from the case studies

Three of our case studies demonstrate the use of White Stork as an umbrella species – at least to some extent. Most prominently, the stork villages (CS2) and the Swedish reintroduction programme (CS3) illustrate how conservation organisations attempt to achieve broader conservation objectives by focusing on a single species. To a lesser degree, in the White Stork and illegal bird hunting in Lebanon (CS1), White Stork served as an umbrella species for other migratory birds – in the sense that it drew attention also to the hunting of other migratory species and the importance of safe migratory routes (interestingly, migratory species are usually not considered good umbrella species [Zacharias and Roff 2001]). Finally, species selected for the "Almost gone" campaign (CS4) served as indicators of broader biodiversity loss.

The social importance of White Stork was the uniting theme in all five case studies, each of which demonstrated strong emphasis on stork images and symbolism. In each of them, White Stork was used as a flagship species that was meant to 'sell' broader conservation objectives, attract tourists to bird habitats, or – in CS5 – commercial products. As a charismatic, flagship species, White Stork was able to attract broad attention to the problem of illegal bird hunting in Lebanon (CS1). In all other case study campaigns, White Stork served as a brand for broader objectives. In stork villages (CS2) and the Swedish reintroduction programme (CS3), White Stork is not only branding conservation but also tourism and local development (tourism flagship species). In Germany (CS4), the stork was selected to illustrate the risks that it faces which are not so well-known.

Among our case studies, CS1 most prominently presents White Stork as a social-ecological keystone species, or at least a local flagship species – *sensu* Bowen-Jones and Entwistle (2002). This campaign involved a message from the Polish society to the Lebanese society – "storks are a key part of our culture, and our connection to nature; please respect this", thus reflecting the social-ecological importance of this species. Interestingly, according to previous reports by BirdLife International (2010), Lebanese hunters preferred shooting migratory species to resident ones among other reasons because they felt no connection to them. To some extent, the stork bears a deeper social-ecological meaning also in stork villages (CS2) and in Sweden (CS3), because of its role in maintaining the culturally meaningful landscape.

Our case studies help to identify the main opportunities and challenges related to the use of various focal species approaches. Only three case studies resonate with our suggested social-ecological perspective (CS1, and to some extent CS2 and CS3), but all five demonstrate both the social and ecological importance of this species to various extents. Additionally, CS2, CS3 and CS5 indicate that the social importance of this species extends beyond environmental conservation. In each case study, White Stork was used as a focal species because storks have positive connotations and attract attention and interest. However, this was not always related to their ecological significance or needs.

Indeed, any social or ecological concept of a focal species alone is not relevant enough from the point of view of broader conservation purposes. There are many border-line cases, making it impossible to distinguish between the social and the ecological within the various terminological distinctions put forward so far. We see the concept of a cultural keystone species as an initial combination of ecological and social, and we propose to extend the understanding and application of this concept to an even more comprehensive social-ecological keystone species. This is in line with the most recent developments of the cultural keystone species "as having essential roles in maintaining any level of complexity within a social–ecological system" (Platten and Henfrey 2009: 491).

From ecological and social to a social-ecological perspective

Scientists increasingly realise the social-ecological context of the world around us. Indeed, the social and the ecological are hardly separable, even if many people still think they are (Berkes et al. 2003). The society and the environment mutually affect each other, but people can make (partly) informed decisions shaping these relationships. Nevertheless, our perception of the world around us is bounded by ignorance. The setting of conservation priorities and even broader conservation approaches is based on our interpretations of the environment and these interpretations have increasingly been considered subjective, reflecting the dominant socio-economic paradigms and priorities of those in power (Ernstson 2013).

So far, the concept of the local flagship species by Bowen-Jones and Entwistle (2002) most comprehensively captured the social-ecological importance of a focal species, explicitly suggesting that – to make it relevant from the point of view of ecosystem management – a flagship species should be ecologically significant. Meanwhile, the related cultural keystone species concept, conceived of as "a convergence point for interdisciplinary collaboration" (Cristancho and Vining 2004: 161), emphasised the human physical and symbolic *use* of species, which reflected their ecological importance only to a limited extent (Platten and Henfrey 2009). Indeed, some authors have already suggested that "future approaches should seek flagships that are also good keystone (or umbrella and indicator) species [...] or that act as surrogates for landscapes" (Leader-Williams and Dublin 2000: 81).

Thus, our proposal is that the concept of cultural keystone species should be extended to new spheres: not only indigenous communities but also modern societies who are more indirectly connected to nature, and not only consumption but all forms of human relationships with other species. Furthermore, it should explicitly address the environmental and ecological significance of the species. This in recognition of a commonly occurring situation in which a species is so important for people that the conservation of many other ecosystem components hinges on the protection of this species. In spite of the commonly held view that people are mostly willing to conserve species that are particularly physically attractive – charismatic, totemic etc. – some studies have found that conservation attributes (information on the status of a certain

species) may rank even higher in terms of the public's support for conservation of those species (Tisdell et al. 2007; Veríssimo et al. 2009).

Our proposed concept is different from the traditional keystone species, which only reflected ecological importance, and from the flagship species which were only meant to "operate in the public relations and fundraising spheres" (Walpole and Leader-Williams 2002: 543; c.f. Andelman and Fagan 2000; Caro et al. 2004; Caro and O'Doherty 1999). As argued by Perry (2010), conservation efforts should focus on key endangered interactions between species, not just on endangered species (which is why we consider the White Stork as a relevant example despite its low extinction risk). Finally, we need to acknowledge that even the ecological keystone species is still vague and empirically unsound (Mills et al. 1993) and that it can only serve as a general guidance to which species are the most relevant for targeted conservation efforts.

We see the concept of a social-ecological keystone species as a comprehensive way to depict these complex interactions and interests involved in bringing the different aspects of species prioritisation into a single indicator. A social-ecological keystone species is likely to be more meaningful for broader conservation objectives because it complements the ecological importance with the social perception of a species, thereby opening an opportunity to connect various dimensions of social/cultural value that people attribute to nature to ecological quality and dynamics. The focus on different interactions, not least relations between humans and other species, supports a different worldview where species and nature conservation is not just for nature's sake but also for our own. The more ways a species, or conservation more broadly, can be linked to people and the values they hold or could cultivate, the more likely it will be that conservation efforts are sustained and successful. The social-ecological keystone species highlights our own role as stewards, with the ultimate target of not only preserving species and ecosystems but also the different avenues for meaningful human interactions with them.

Selecting social-ecological keystone species

The selection and use of social-ecological keystone species can be aided by cultural creation and branding. The status of a social-ecological keystone species may result from its contribution to the maintenance of selected types of landscapes, which may be culturally important, as in the case of White Stork and rural landscapes in Southern Sweden and Central and Eastern Europe, or – similarly – in Japan in the case of another stork species (Naito et al. 2014). In such a case, the ecological importance of a social-ecological keystone species refers to the preservation of a human-dominated ecosystem where the species have closely interacted with people and human land uses.

Selection principles matter. They are particularly relevant for engaging with the broader society and in education, and they can help to achieve broader conservation objectives beyond the support for particular conservation projects. For these reasons

social-ecological keystone species is also better than the traditional single species approaches, which have been deemed insufficient to ensure the conservation of broader biodiversity (Williams et al. 2000; Andelman and Fagan 2000). Meanwhile, the main advantage of using separate approaches would be not to overload the audience with too much information regarding one species. However, we argue that communicating the social-ecological connections is important enough to warrant the additional effort and to more accurately select the focal species, especially in a modern, industrialised society.

A limitation might be that for many ecosystems we may not be able to readily find species that would be recognised as socially and ecologically important by modern societies. However, again this provides excellent opportunity for more comprehensive education than in the case of pure flagship species. It maintains the appeal of a flagship species (Barua 2011), but narrows down the selection of potential species to those that are ecologically relevant. Such education and awareness-raising can be extended to international contexts, as in our CS1 on illegal bird hunting in the Mediterranean within which an attempt was made to inform one society about the importance of some species for the other.

Bees constitute another good example, where more and more lay people are concerned about their situation (Brown and Paxton 2009). The fact that such a broad attention has been paid to bees recently illustrates the cultural creation of a social-ecological keystone species (or a group of species in this case). In fact, the example of the bees indicates the rediscovery of the social-ecological importance of a (group of) species, because they have always been important to people. Only recently the deteriorating environmental conditions that have led to their decline have brought them to broader attention and have successfully contributed to broader calls for environmental protection (Moore and Kosut 2013).

To this point, Platten and Henfrey (2009: 496) suggested that "Formulating the cultural keystone concept in systemic terms demands that it refer not to biological species, but to complexes of interconnected material and subjective factors." This approach, which was not reflected in the original cultural keystone species concept, well illustrates the social-ecological extension that we are advocating in the present article. In the case of yet another pollinator, the monarch butterfly, the special status was co-produced principally through partnerships among various actors: those already involved in conservation, and others who associated potential involvement with their personal interest (e.g. to demonstrate corporate social responsibility) (Gustafsson et al. 2015). However, although many examples of social-ecological keystone species are available, there is no simple prescription on how to promote such an approach, especially with regard to non-charismatic species. Additionally, some social-ecological keystone species are not necessarily unanimously accepted by people, especially when they are considered problematic by some groups, such as the abovementioned tiger and lion or wolf and other large predators. Still, highlighting the ecological component within a social-ecological approach may add much importance to those species, the social appeal of which is not sufficient to ensure their special status and conservation.

Conclusions

White Stork provides an important example of a focal species used in different conservation campaigns and in broader social communications, addressing a range of targets. It is most often used because of its social appeal, and while its ecological importance is not similarly spectacular, it is still a valid argument for conservation. This species has a long history of coexistence with humans, and many linkages with specific cultural practices. Hence, White Stork offers an excellent example for discussing the broader social-ecological relevance of species.

Although we do not expect the concept of a social-ecological keystone species to replace the ecological concepts of a focal species, which have their well-established uses in biological and ecological science, we argue that a social-ecological keystone species in principle should be more relevant than a typical social focal species approach (such as flagship species). The added value of a social-ecological keystone species compared to traditional socially-defined focal species approach relates to the higher transparency of the former. A social-ecological approach avoids the specific focus or hidden agendas of specific groups of interested stakeholders who might favour the conservation of certain species over the other, it ensures that these species are relevant to broader social spheres, and it ensures that the selected focal species will indeed help to solve broader environmental problems and will not only serve as conservation mascots. It also demands that that the inherent ecology is easily understood and related to in a way that is meaningful to people.

The social-ecological keystone species concept, where selected species have clear connections to ecological qualities and dynamics can make people (understood as a diverse group of stakeholders) aware that their "preferred" species is a product of ecosystem processes and interactions (and often ecosystems where humans are a dominating force). Thus, conservation projects referring to the idea of a social-ecological keystone species highlight the importance of the connections between the social and the ecological, providing a very good opportunity for ecological education and nurturing a sense of responsibility for nature conservation and additional benefits of biodiversity (Andersson et al. 2015). Many of the other concepts and traditional approaches rely on the mediator, the conservation agency or similar, to make sure that the public image and understanding of the species is translated into relevant action. This means there is a potential disconnect between public awareness and interest, and the actual on-the-ground conservation work (Schlegel and Rupf 2010). Hopefully, the social-ecological keystone species concept would bridge and integrate these two sides more smoothly and engage people more directly, which would also take some of the weight off (and dependence on) the conservation agents.

Nevertheless, the social-ecological keystone species is still not likely to solve some important challenges related to previously used concepts of ecological and social focal species. The different focal species concepts are frequently used in an imprecise manner (Barua 2011) and we cannot be certain that a new – and even more complex concept – will not add ambiguity to current discussions. Also, as our environmental management practices are bounded by ignorance regarding ecosystem functioning, a focus on

selected keystone species may miss other species that are at least as important even if we are not aware of them or their importance. While this problem may become even more severe with further environmental change, it also affects all other environmental management decisions.

In short, a social-ecological keystone species can be used in practice to define conservation objectives and to further ecological education, showing how people and the environment are interlinked through selected relatively easily recognised species. It can be used as part of broader systems of indicators used for environmental management that incorporate social and ecological contexts to "evaluate the state of cultural wellbeing associated with different ecosystems and address the conditions which threaten or enable these conditions to thrive" (Poe et al. 2014: 173). The social-ecological keystone species builds on non-monetary approaches to the identification of important species, drawing on social psychology, conservation psychology, ecological anthropology, human ecology, folkbiology, enthnobiology and to the notion of biocultural diversity and biocultural importance, all of which can provide insights into the complex social-ecological background of different species.

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References

Andelman SJ, Fagan WF (2000) Umbrellas and flagships: efficient conservation surrogates or expensive mistakes? Proceedings of the National Academy of Sciences 97(11): 5954–5959. https://doi.org/10.1073/pnas.100126797

Andersson E, Tengö M, McPhearson T, Kremer P (2015) Cultural ecosystem services as a gateway for improving urban sustainability. Ecosystem Services 12: 165–168. https://doi.org/10.1016/j.ecoser.2014.08.002

Bairlein F (1991) Population studies of White storks (Ciconia ciconia) in Europe. In: Perrins CM, Lebreton JD, Hirons GJM (Eds) Bird Population Studies. Oxford University Press, Oxford, 207–229.

Barua M (2011) Mobilizing metaphors: the popular use of keystone, flagship and umbrella species concepts. Biodiversity and Conservation 20(7): 1427–1440. https://doi.org/10.1007/s10531-011-0035-y

Bense AR (2006) "Was Sie schon immer über den Klapperstorch wissen wollten..." – Zu den kulturhistorischen Grundlagen des Kinderbringers. Charadrius 41(1–2): 66–73.

Bense AR (2014) Vom unglaublich vielfältigen Bild des Weißstorchs auf historischen Ansichtskarten. Westarp Wissenschaften, Hohenwarsleben, 127 pp.

Berkes F (2009) Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. Journal of Environmental Management 90(5): 1692–1702. https://doi.org/10.1016/j.jenvman.2008.12.001

Berkes F, Colding J, Folke C (2003) Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press, Cambridge, 416 pp

BirdLife International (2010) Towards sustainable hunting in the Middle East. Presented as part of the BirdLife State of the world's birds website. BirdLife International, Cambridge.

Błoszyk J, Gwiazdowicz DJ, Bajerlein D, Halliday RB (2005) Nests of the white stork Ciconia ciconia (L.) as a habitat for mesostigmatic mites (Acari, Mesostigmata). Acta Parasitologica 50(2): 171–175.

Bocian M (2017) Wykorzystanie wizerunków zwierząt przez firmy w celach promocyjnych na przykładzie Grupy Atlas. MSc thesis. University of Lodz, Lodz, 104 pp. [In Polish]

Bossart G (2006) Marine mammals as sentinel species for oceans and human health. Oceanography 19(2): 134–137, https://doi.org/10.5670/oceanog.2006.77

Bowen-Jones E, Entwistle A (2002) Identifying appropriate flagship species: the importance of culture and local contexts. Oryx 36(2): 189–195. https://doi.org/10.1017/S0030605302000261

Brown MJF, Paxton RJ (2009) The conservation of bees: a global perspective. Apidologie 40(3): 410–416. https://doi.org/10.1051/apido/2009019

CABS, LEM (2013) Report on the hunting of migrant birds in the Lebanon – affected species and their conservation status in the EU. Committee Against Bird Slaughter & Lebanon Eco Movement, Bonn, 32 pp.

Carignan V, Villard MA (2002) Selecting indicator species to monitor ecological integrity: a review. Environmental Monitoring and Assessment 78(1): 45–61. https://doi.org/10.1023/A:1016136723584

Caro T, Engilis A, Fitzherbert E, Gardner T (2004) Preliminary assessment of the flagship species concept at a small scale. Animal Conservation 7(1): 63–70. https://doi.org/10.1017/S136794300300115X

Caro TM, O'Doherty G (1999) On the use of surrogate species in conservation biology. Conservation Biology 13(4): 805–814. https://doi.org/10.1046/j.1523-1739.1999.98338.x

Cavallin B (1997) Storklandskapet. Skånes Natur 84: 1–160.

Clucas B, McHugh K, Caro T (2008) Flagship species on covers of US conservation and nature magazines. Biodiversity and Conservation 17(6): 1517–1528, https://doi.org/10.1007/s10531-008-9361-0

Creutz G (1985) Der Wießtorch Ciconia ciconia. Ziemsen Verlag, Lutherstadt Wittenberg, 216 pp.

Cristancho S, Vining J (2004) Culturally defined keystone species. Human Ecology Review 11(2): 153–164

Czajkowski M, Giergiczny M, Kronenberg J, Tryjanowski P (2014) The economic recreational value of a white stork nesting colony: A case of 'stork village' in Poland. Tourism Management 40: 352–360, https://doi.org/10.1016/j.tourman.2013.07.009

Czarnecka J, Kitowski I (2013) The white stork as an engineering species and seed dispersal vector when nesting in Poland. Annales Botanici Fennici 50(1–2): 1–12. https://doi.org/10.5735/085.050.0101

Descola P, Palsson G (Eds) (1996) Nature and Society: Anthropological Perspectives. Routledge, London and New York, 322 pp. https://doi.org/10.4324/9780203451069

Entwistle A (2000) Flagships for the future? Oryx 34(4): 239–240. https://doi.org/10.1046/j.1365-3008.2000.00140.x

Entwistle AC, Mickleburgh S, Dunstone N (2000) Mammal conservation: current contexts and opportunities. In: Entwistle AC, Dunstone N (Eds) Priorities for the Conservation of Mammalian Diversity: Has the Panda Had Its Day? Cambridge University Press, Cambridge, 1–10.

Ernstson H (2013) The social production of ecosystem services: A framework for studying environmental justice and ecological complexity in urbanized landscapes. Landscape and Urban Planning 109(1): 7–17. https://doi.org/10.1016/j.landurbplan.2012.10.005

Everard M, Kataria G (2011) Recreational angling markets to advance the conservation of a reach of the Western Ramganga River, India. Aquatic Conservation: Marine and Freshwater Ecosystems 21(1): 101–108. https://doi.org/10.1002/aqc.1159

Favreau JM, Drew CA, Hess GR, Rubino MJ, Koch FH, Eschelbach KA (2006) Recommendations for assessing the effectiveness of surrogate species approaches. Biodiversity & Conservation 15(12): 3949–3969. https://doi.org/10.1007/s10531-005-2631-1

Ferger SW, Schwaderer G (2016) The European Stork Villages – a successful combination of nature conservation and sustainable development of rural areas. In: Jerzak L, Shephard J, Aguirre JI, Shamoun-Baranes J, Tryjanowski P (Eds) The White Stork. Studies in Biology, Ecology and Conservation. Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra, 219–226.

Ferreday D (2012) Affect, fantasy and digital cultures. In: Karatzogianni A, Kuntsman A (Eds) Digital Cultures and the Politics of Emotion: Feelings, Affect and Technological Change. Palgrave Macmillan, Basingstoke, 77–93. https://doi.org/10.1057/9780230391345_5

Garibaldi A, Turner N (2004) Cultural keystone species: implications for ecological conservation and restoration. Ecology and Society 9(3): art. 1. https://doi.org/10.5751/ES-00669-090301

Gould SJ (1980) A biological homage to Mickey Mouse. The Panda's Thumb: More Reflections in Natural History. Norton, New York, 95–107.

Gunnthorsdottir A (2001) Physical attractiveness of an animal species as a decision factor for its preservation. Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals 14(4): 204–215. https://doi.org/10.2752/089279301786999355

Gustafsson KM, Agrawal AA, Lewenstein BV, Wolf SA (2015) The Monarch Butterfly through time and space: the social construction of an icon. BioScience 65(6): 612–622. https://doi.org/10.1093/biosci/biv045

Herremans M, Herremans-Tonnoeyr D (1993) White Storks Ciconia ciconia, Abdim's Storks Ciconia abdimii and Kites Milvus migrans feeding on mopane worms. Babbler 25: 40.

Heydinger J (2014) Cultural Ecosystem Services and the Avifauna of the Western Cape: A social-ecological systems investigation. MPhil thesis. University of Cape Town, Cape Town, 100 pp.

Heywood VH (Ed.) (1995) Global biodiversity assessment. Cambridge University Press, Cambridge, 1152 pp.

Home R, Keller C, Nagel P, Bauer N, Hunziker M (2009) Selection criteria for flagship species by conservation organizations. Environmental Conservation 36(2): 139–148. https://doi.org/10.1017/S0376892909990051

Indykiewicz P (1998) Breeding of the House Sparrow Passer domesticus, Tree Sparrow P. montanus, and Starling Sturnus vulgaris in the White Stork Ciconia ciconia nests. Notatki Ornitologiczne 39(2): 97–104.

Jacquet J, Pauly D (2008) Funding priorities: big barriers to small-scale fisheries. Conservation Biology 22(4): 832–835. https://doi.org/10.1111/j.1523-1739.2008.00978.x

Jepson P, Barua M (2015) A theory of flagship species action. Conservation and Society 13(1): 95–104. https://doi.org/10.4103/0972-4923.161228

Kalland A (1993) Management by totemization: whale symbolism and the anti-whaling campaign. Arctic 46(2): 124–133. https://doi.org/10.14430/arctic1333

Kamiński P, Kurhalyuk N, Kasprzak M, Jerzak L, Tkachenko H, Szady-Grad M, Klawe JJ, Koim B (2008) The impact of element–element interactions on antioxidant enzymatic activity in the blood of White Stork (Ciconia ciconia) chicks. Archives of Environmental Contamination and Toxicology 56(2): 325–337. https://doi.org/10.1007/s00244-008-9178-6

Karlsson J (1989) Storken åter i Skåne. Anser 28: 85–86.

Kontoleon A, Swanson T (2003) The willingness to pay for property rights for the giant panda: can a charismatic species be an instrument for nature conservation? Land Economics 79(4): 483–499. https://doi.org/10.3368/le.79.4.483

Kosicki JZ, Sparks TH, Tryjanowski P (2007) House sparrows benefit from the conservation of white storks. Naturwissenschaften 94(5): 412–415. https://doi.org/10.1007/s00114-006-0207-x

Kotler P, Roberto N, Lee N (2002) Social marketing: Improving the quality of life, 2nd ed. Sage, Thousand Oaks, CA, 438 pp.

Kozera CA (2014) White storks killings in Lebanon and the effort to stop it: the role of social media in spreading and counteracting the phenomenon. Studies in Global Ethics and Global Education 1(1): 80–104. https://doi.org/10.5604/2354029X.1111242

Kronenberg J (2015) Zasoby przyrodnicze a rozwój lokalny: studium przypadku dwóch bocianich wiosek w Polsce (Natural resources and local development: case study of two stork villages in Poland). Acta Universitatis Lodziensis Folia Oeconomica 313(2): 113–128. https://doi.org/10.18778/0208-6018.313.08 [In Polish]

Kronenberg J (2016) Birdwatchers' wonderland? Prospects for the development of birdwatching tourism in Poland. Journal of Ecotourism 15(1): 78–94. https://doi.org/10.1080/14724049.2016.1142556

Kronenberg J, Bocheński M, Dolata PT, Jerzak L, Profus P, Tobółka M, Tryjanowski P, Wuczyński A, Żołnierowicz KM (2013) Znaczenie bociana białego Ciconia ciconia dla społeczeństwa: analiza z perspektywy koncepcji usług ekosystemów [The social importance of White Stork Ciconia ciconia: an analysis from the perspective of ecosystem services]. Chrońmy Przyrodę Ojczystą 69(3): 3–27. [In Polish]

Leader-Williams N, Dublin HT (2000) Charismatic megafauna as 'flagship species.' In: Entwistle A, Dunstone N (Eds) Priorities for the Conservation of Mammalian Diversity: Has the Panda Had Its Day? Cambridge University Press, Cambridge, 53–81.

Lorimer J (2007) Nonhuman charisma. Environment and Planning D: Society and Space 25(5): 911–932. https://doi.org/10.1068/d71j

Lower WR, Kendall RJ (1990) Sentinel species and sentinel bioassay. In: McCarthy JF, Shugart LR (Eds) Biomarkers of Environmental Contamination. Lewis Publishers, Boca Raton, FL, 309–331.

Martín-López B, Montes C, Benayas J (2007) The non-economic motives behind the willingness to pay for biodiversity conservation. Biological Conservation 139(1–2): 67–82. https://doi.org/10.1016/j.biocon.2007.06.005

Martín-López B, Montes C, Benayas J (2008) Economic valuation of biodiversity conservation: the meaning of numbers. Conservation Biology 22(3): 624–635. https://doi.org/10.1111/j.1523-1739.2008.00921.x

Mills LS, Soulé ME, Doak DF (1993) The keystone-species concept in ecology and conservation. BioScience 43(4): 219–224. https://doi.org/10.2307/1312122

Milstein P le S (1966) Preliminary observations of white storks feeding on poisoned brown locusts. Ostrich 37(sup1): 197–215. https://doi.org/10.1080/00306525.1966.9639799

Moore LJ, Kosut M (2013) Buzz: Urban Beekeeping and the Power of the Bee. NYU Press, New York, 252 pp

Naito K, Kikuchi N, Ohsako Y (2014) Role of the Oriental White Stork in Maintaining the Cultural Landscape in the Toyooka Basin, Japan. In: Hong SK, Bogaert J, Min Q (Eds) Biocultural Landscapes. Springer, Dordrecht, 33–44. https://doi.org/10.1007/978-94-017-8941-7_4

Nilsson L (1989) 500 år i Skåne? Den vita storkens historia i Sverige. Anser 28: 115–124.

Perry N (2010) The ecological importance of species and the Noah's Ark problem. Ecological Economics 69(3): 478–485. https://doi.org/10.1016/j.ecolecon.2009.09.016

Platten S, Henfrey T (2009) The cultural keystone concept: insights from ecological anthropology. Human Ecology 37(4): 491–500. https://doi.org/10.1007/s10745-009-9237-2

Poe MR, Norman KC, Levin PS (2014) Cultural Dimensions of Socioecological Systems: Key Connections and Guiding Principles for Conservation in Coastal Environments. Conservation Letters 7(3): 166–175. https://doi.org/10.1111/conl.12068

Power ME, Tilman D, Estes JA, Menge BA, Bond WJ, Mills LS, Daily G, Castilla JC, Lubchenco J, Paine RT (1996) Challenges in the quest for keystones. BioScience 46(8): 609–620. https://doi.org/10.2307/1312990

Rimberth C (2013) The swedish white stork reintroduction programme. Lund University, Lund, 67 pp.

Roberge JM, Angelstam P (2004) Usefulness of the umbrella species concept as a conservation tool. Conservation Biology 18(1): 76–85. https://doi.org/10.1111/j.1523-1739.2004.00450.x

Rodrigues ASL, Pilgrim JD, Lamoreux JF, Hoffmann M, Brooks TM (2006) The value of the IUCN Red List for conservation. Trends in Ecology & Evolution 21(2): 71–76. https://doi.org/10.1016/j.tree.2005.10.010

Sattout EJ, Talhouk SN, Caligari PDS (2007) Economic value of cedar relics in Lebanon: An application of contingent valuation method for conservation. Ecological Economics 61(2–3): 315–322. https://doi.org/10.1016/j.ecolecon.2006.03.001

Schlegel J, Rupf R (2010) Attitudes towards potential animal flagship species in nature conservation: A survey among students of different educational institutions. Journal for Nature Conservation 18(4): 278–290. https://doi.org/10.1016/j.jnc.2009.12.002

Scott JM, Tear TH, Mills LS (1995) Socioeconomics and the recovery of endangered species: biological assessment in a political world. Conservation Biology 9(1): 214–216. https://doi.org/10.1046/j.1523-1739.1995.09010214.x

Serpell J (2004) Factors influencing human attitudes to animals and their welfare. Animal Welfare 13(1): 145–151.

Simberloff D (1998) Flagships, umbrellas, and keystones: is single-species management passé in the landscape era? Biological Conservation 83(3): 247–257. https://doi.org/10.1016/S0006-3207(97)00081-5

Soulé ME, Estes JA, Berger J, Del Rio CM (2003) Ecological effectiveness: conservation goals for interactive species. Conservation Biology 17(5): 1238–1250. https://doi.org/10.1046/j.1523-1739.2003.01599.x

Tisdell C, Swarna Nantha H (2007) Comparison of funding and demand for the conservation of the charismatic koala with those for the critically endangered wombat Lasiorhinus krefftii. Biodiversity and Conservation 16(4): 1261–1281. https://doi.org/10.1007/s10531-006-6735-z

Tisdell C, Swarna Nantha H, Wilson C (2007) Endangerment and likeability of wildlife species: How important are they for payments proposed for conservation? Ecological Economics 60(3): 627–633. https://doi.org/10.1016/j.ecolecon.2006.01.007

Tisdell C, Wilson C, Swarna Nantha H (2006) Public choice of species for the 'Ark': Phylogenetic similarity and preferred wildlife species for survival. Journal for Nature Conservation 14(2): 97–105. https://doi.org/10.1016/j.jnc.2005.11.001

Tobolka M (2011) Roosting of tree sparrow (Passer montanus) and house sparrow (Passer domesticus) in white stork (Ciconia ciconia) nests during winter. Turkish Journal of Zoology 35(6): 879–882.

Tobolka M, Sparks TH, Tryjanowski P (2012) Does the White Stork Ciconia ciconia reflect farmland bird diversity? Ornis Fennica 89: 222–228.

Tryjanowski P, Kuzniak S (2002) Population size and productivity of the White Stork Ciconia ciconia in relation to Common Vole Microtus arvalis density. Ardea 90(2): 213–217.

Tryjanowski P, Sparks T, Jerzak L (Eds) (2006) The White Stork in Poland: Studies in Biology, Ecology and Conservation. Bogucki, Poznań, 492 pp.

Uliczka H, Angelstam P (2000) Assessing conservation values of forest stands based on specialised lichens and birds. Biological Conservation 95(3): 343–351. https://doi.org/10.1016/S0006-3207(00)00022-7

Ullmann J, Stachowitsch M (2015) A critical review of the Mediterranean sea turtle rescue network: a web looking for a weaver. Nature Conservation 10: 45–69. https://doi.org/10.3897/natureconservation.10.4890

Veríssimo D, Fraser I, Groombridge J, Bristol R, MacMillan DC (2009) Birds as tourism flagship species: a case study of tropical islands. Animal Conservation 12(6): 549–558. https://doi.org/10.1111/j.1469-1795.2009.00282.x

Vesey-FitzGerald DF (1959) Locust control operations and their possible effect on the population of the White Stork Ciconia Ciconia. Ostrich 30(2): 65–68. https://doi.org/10.1080/00306525.1959.9639336

Walpole MJ, Leader-Williams N (2002) Tourism and flagship species in conservation. Biodiversity & Conservation 11(3): 543–547. https://doi.org/10.1023/A:1014864708777

Wiesehomeier N, Willinger G, Grund K (2014) European Stork Villages: where storks are honorary citizens. EuroNatur, Radolfzell, 9 pp.

Williams PH, Burgess ND, Rahbek C (2000) Flagship species, ecological complementarity and conserving the diversity of mammals and birds in sub-Saharan Africa. Animal Conservation 3(3): 249–260. https://doi.org/10.1111/j.1469-1795.2000.tb00110.x

Zacharias MA, Roff JC (2001) Use of focal species in marine conservation and management: a review and critique. Aquatic Conservation: Marine and Freshwater Ecosystems 11(1): 59–76. https://doi.org/10.1002/aqc.429

Żmihorski M, Dziarska-Pałac J, Sparks TH, Tryjanowski P (2013) Ecological correlates of the popularity of birds and butterflies in Internet information resources. Oikos 122(2): 183–190. https://doi.org/10.1111/j.1600-0706.2012.20486.x